§27. Impurity Line Emission Survey in the VUV Domain on NBI-heated Heliotron J Plasmas

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In order to gain a better understanding of the effect of impurities on a Heliotron J plasma, a spatial structure and its dynamics of a radiation loss, especially dominant impurity line emissions, in the Heliotron J plasmas should be investigated. We have already developed a radiation profile measurement system, which consists of an Absolute XUV photoDiode (AXUVD, IRD inc., AXUV-16ELO/G) array and a filter wheel[1). The filter wheel allows us to set an optimum optical filter for studying the dominant impurity line emissions in accordance with the condition of Heliotron J plasmas. In the FY2010 Heliotron J experiment, an impurity line emission survey in the vacuum ultraviolet (VUV) domain on the current Helitron J plasma was done to look for the best impurity line emissions to be studied. This reports about the result on the NBI-heated Heliotron J plasma. Figure 1 shows typical spectra in VUV domain (λ = 16.5 ~ 39.5 nm) of the NBI-heated Heliotron J plasma. In this case, a magnetic configuration of the Heliotron J is set at the standard configuration and a sightline of the VUV spectrometer is set on the equatorial plane. As can be seen in Fig. 1, when a plasma density is increased, many impurity line emissions, especially Fe VII (λ = 23.37 nm, Ionization Potential (I.P.) = 126.0 eV) and Fe XVI (λ = 33.54 nm, I.P. = 489.3 eV), are appeared. In the higher density case, as shown in Fig. 2, the Fe XVII emission intensity is increased exponentially with time and the Fe XVI emission intensity is also increased with time and seems to be saturated. Figure 3 shows a VUV spectrometer sightline angle dependence of the spectrally integrated intensity of both Fe VII and Fe XVI in the high-density NBI-heated Heliotron J plasma. As can be easily recognized from Fig. 3, both Fe VII and Fe XVI profiles become peaked one at the final phase of the discharge, although it should be noted here that the integrated intensity is sightline-integrated. Thus it seems highly likely that an impurity accumulation arises in the high-density NBI-heated Heliotron J plasma. And the Fe VII and Fe XVI seems to be a good indicator of the impurity transport in the NBI-heated Heliotron J plasma, that is the Fe VII and Fe XVI seems to be the optimum impurity line emission for the study of the effect of impurities on the NBI-heated Heliotron J plasmas.

1) N. Tamura et al.: Ann. Rep. NIFS (2007-2008) 509.

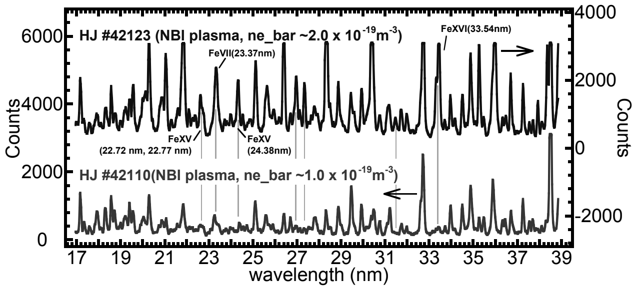

Fig. 1. Typical spectra in the VUV domain observed in the NBI-heated Heliotorn J plasma.

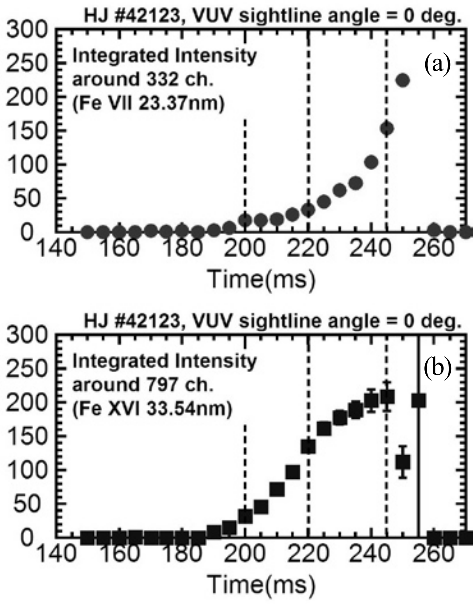

Fig. 2. Temporal evolutions of the spectrally integrated intensity for (a) Fe VII (23.37 nm) and (b) Fe XVI (33.54 nm) in the case of Fig. 1.

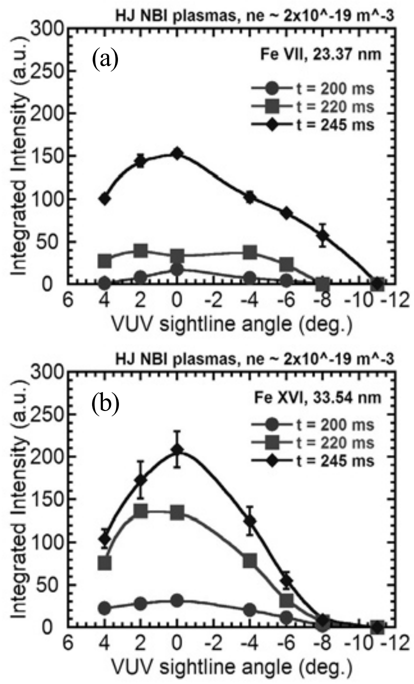

Fig. 3. VUV spectrometer sightline angle dependence of the spectrally integrated intensity of (a) Fe VII and (b) Fe XVI in the high-density NBI-heated Heliotron J plasma.